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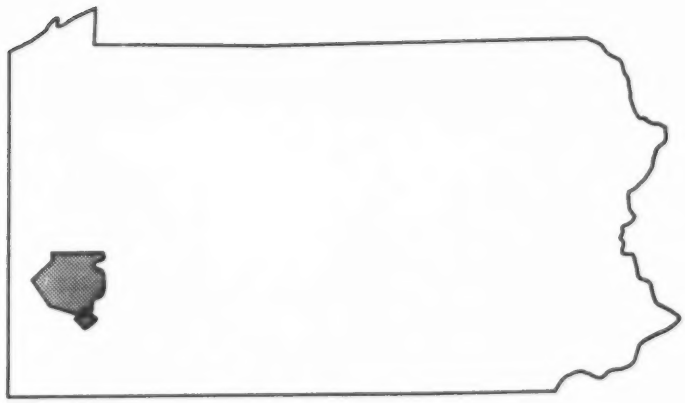
FLOOD INSURANCE STUDY

BOROUGH OF ELIZABETH, PENNSYLVANIA
ALLEGHENY COUNTY



JANUARY 16, 1981

federal emergency management agency
federal insurance administration

COMMUNITY NUMBER - 421263

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Borough of Elizabeth, Allegheny County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert Elizabeth to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally-supported studies are based. These criteria take precedence over the minimum federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3. In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by the Pittsburgh District of the U. S. Army Corps of Engineers for the Federal Insurance Administration, under Inter-Agency Agreement No. IAA-H-18-78. This work was completed in January 1980.

1.3 Coordination

Notice of Initiation of Study letters dated August 24, 1978, were sent to all federal, state, county and local government agencies and private firms that could possibly make input to the study. An initial Consultation and Coordination Officer's (CCO) meeting was held on December 13, 1977, with the Borough Secretary and the U. S Army Corps of Engineers (COE - the study contractor).

On August 13, 1980, the study was reviewed at the final CCO meeting, attended by the COE, the FIA, and borough officials.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Borough of Elizabeth, Allegheny County, Pennsylvania. The area of study is shown on the Vicinity Map (Figure 1).

The Monongahela River was studied by detailed methods within the corporate limits. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction for the next five years, through January 1985.

Fallen Timber Run and Smith Run were studied by approximate methods. Approximate methods of analysis were used to study those areas having low development potential and minimal flood hazards as identified at the initiation of the study. The scope and methods of study were proposed to and agreed upon by the FIA. Flooding on these streams was found to be controlled completely by flooding from the Monongahela River, and no approximate flood boundaries were mapped along these streams.

2.2 Community Description

The Borough of Elizabeth is located in southwestern Pennsylvania in the southeastern section of Allegheny County. The borough is on the right or east bank of the Monongahela River. The total land area contained within the corporate limits is 0.3 square mile. Elizabeth is located approximately 12 miles south of Pittsburgh, Pennsylvania. According to U.S. Census Bureau figures, the population was 2,273 in 1970 (Reference 1).

The Monongahela River, with a drainage area of 7,384 square miles at its mouth, joins with the Allegheny River to form the Ohio River at Pittsburgh. The Monongahela River is formed by the junction of the West Fork and Tygart Rivers at Fairmont, West Virginia, 128.73 river miles upstream of Pittsburgh. The headwaters of these rivers are located on the western slope of the Appalachian Mountains in Lewis, Upshur and Randolph Counties in northwestern West Virginia. The Monongahela River flows generally north throughout its entire length, and northeast within the Borough of Elizabeth.

The Monongahela River watershed consists of a relatively narrow valley with steep hillside slopes. The steep hills, typical of the basin, are conducive to rapid initial runoff into the valley. The river gradient on the Monongahela River is relatively flat while those of the West Fork and Tygart Rivers are much steeper. Most of the watershed basin consists of forested hills and narrow bottom land. Upland clearings in the southern

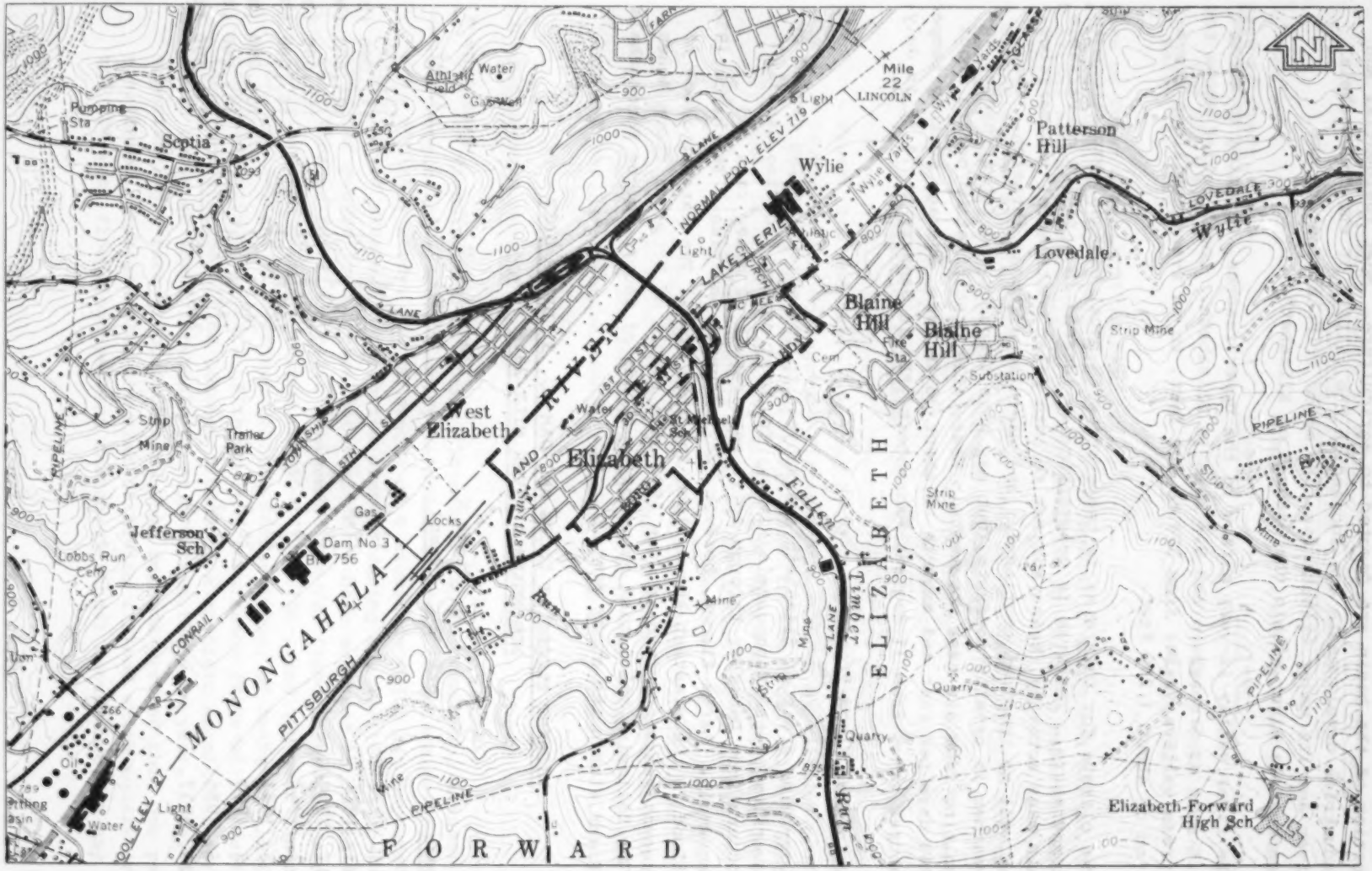


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

BOROUGH OF ELIZABETH, PA
(ALLEGHENY CO.)

APPROXIMATE SCALE
2000 0 2000 4000 6000 FEET

VICINITY MAP

portion of the basin are devoted to agriculture. Most residential and industrial developments are located in the valleys of the Monongahela River and its major tributaries. No major tributary enters the Monongahela River within the Borough of Elizabeth.

The river valley is very narrow in the upper reaches, widening to about 0.5 mile at Greensboro and 0.4 mile in Elizabeth. Local relief above the stream valleys varies from 300 to 400 feet, to an average hilltop elevation of about 1,200 feet.

The climate for this area is temperate with usual seasonal variations in temperature. The area is geographically located in a region of variable air mass activity, being subject to both polar continental and maritime, as well as tropical continental and maritime air mass invasion. The weather is usually moderate, but may have frequent and rapid changes resulting from air mass movements. Measurable precipitation occurs about 149 days per year and amounts to about 36 inches. Average monthly temperatures range from 31 degrees Fahrenheit (°F) in January to 74 °F in July.

2.3 Principal Flood Problems

Low-lying areas of Elizabeth are subject to periodic flooding caused by overflow of the Monongahela River. The most severe flooding usually occurs from December through April as a result of heavy rain and snowmelt. Large floods, however, may occur at any time. The March 1936 flood is the greatest known flood for this area. The largest flood of recent years occurred in June 1972 as a result of Tropical Storm Agnes. The following tabulation shows major floods of record on the Monongahela River within the study area.

HIGHEST FLOODS AT LOCKS AND DAM NO. 3 UPPER GAGE
MONONGAHELA RIVER MILE 23.8

Date of Crest	Stage c (feet)	Elevation c (feet)	Discharge a (cfs)
March 18, 1936	32.5	750.4	153,000
June 23, 1972	29.0	746.9 (b)	137,000 (b)
October 17, 1954	28.5	746.4 (b)	141,000 (b)
March 7, 1967	28.3	746.2 (b)	158,000 (b)
June 5, 1941	27.9	745.8 (b)	143,000 (b)
March 5, 1963	26.5	744.4 (b)	154,000 (b)
August 6, 1956	26.1	744.0 (b)	133,000 (b)
October 29, 1937	25.9	743.8 (b)	130,500 (b)

HIGHEST FLOODS AT LOCKS AND DAM NO. 3 UPPER GAGE
MONONGAHELA RIVER MILE 23.8 (continued)

Date of Crest	Stage c (feet)	Elevation c (feet)	Discharge a (cfs)
May 25, 1968	25.6	743.5 (b)	127,000 (b)
March 25, 1936	25.0	742.9	133,000

Zero of Upper Gage is 717.9 feet

a At Lock and Dam No. 4. Discharges not computed at Locks and Dam No. 3

b Actual elevations and discharges are modified by existing reservoir at time of flood

c Stages may be affected from backwater from Youghiogheny River. Stages prior to November 1967 were adjusted to present zero gage.

2.4 Flood Protection Measures

Tygart Dam and Lake, operated by the COE, are effective in reducing flood levels on the Monongahela River in the Borough of Elizabeth. This flood control dam and reservoir are located on the Tygart River, about 60 miles south in Grafton, West Virginia, and reduce major flooding at Lock and Dam No. 4, approximately 20 miles downstream, by an average of 4 feet.

A flood control dam upstream of Weston , West Virginia, on the West Fork River has been authorized and funded to begin construction in 1978. Another flood control dam at Rowlesburg, West Virginia, on the Cheat River is authorized to be constructed in the future.

3.0 ENGINEERING METHODS

For the flooding source studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one-percent chance of annual occurrence) in any 50-year

period is about 40 percent (four in ten) and, for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for the flooding source studied in detail affecting the community.

Flood-flow frequency data for the Monongahela River were based on a statistical analysis of stage-discharge records covering a 36-year period at Lock and Dam No. 4, located in the Borough of Charleroi, Pennsylvania. The gaging station was jointly operated by the U. S. Geological Survey (USGS) and the COE until September 1976 when the USGS gaging station was moved to Locks and Dam No. 3. Gage readings have been maintained at Lock and Dam No. 4, at its present location, since August 1932. From December 1885 to August 1932, Lock and Dam No. 4 was located 0.6 mile downstream of its present lcoation. Reconstruction of Dam No. 4 was completed in June 1967. Records are maintained by the Pittsburgh District of the COE. The actual peak flows at Lock and Dam No. 4 were adjusted for the effects of Tygart Lake since October 1937 to compute natural peak flows for each flood event at Lock and Dam No. 4. Gage readings have also been maintained at Locks and Dam No. 3, just upstream of Elizabeth, since May 1907. The gaging station has been jointly operated by the USGS and the COE since October 1976. Official Lockmaster records are maintained by the Pittsburgh District of the COE.

The natural peak discharge-frequency curves on the Monongahela River were developed following the standard log-Pearson Type III method as outlined by the Water Resources Council Bulletin 17A (Reference 2). An average reduction curve was developed from the actual flows at Lock and Dam No. 4 and the natural flows which were adjusted for the effects of the Tygart River Dam. The natural flood-flow discharges for the selected frequencies were then modified by means of this average reduction curve to obtain the modified flow values. The flows at Locks and Dam No. 3 were assumed to be the same as those developed for Lock and Dam No. 4. A summary of drainage area-peak discharge relationships for the stream studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
MONONGAHELA RIVER					
At Locks and Dam No. 3	5,340	135,500	167,000	182,500	216,400

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding source studied in detail were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along this flooding source.

Cross section data for the Monongahela River were taken from COE soundings and topographic maps (Reference 3). Field checks were made if any information was questionable or if an area required specific roughness inspection and evaluation.

Roughness coefficients (Manning's "n") were chosen on the basis of field inspection and the verification of roughness requirements to reproduce profiles for known floods for which high-water marks and flow quantities were obtained or measured. For the Monongahela River, the well-defined floods of 1963, 1967, 1972 and the moderate flood of 1968 were reproduced successfully using a channel "n" ranging between 0.027 and 0.029, and an overbank "n" of 0.060.

A study made in 1975 by the COE between the mouth of the Monongahela River and Lock and Dam No. 4 indicated that for a 500-year magnitude flow the maximum water-surface differential induced by totally obstructing overbank areas was 0.5 foot, with an average difference of only 0.2 foot (Reference 4). It was concluded, therefore, that overbank flow is relatively ineffective.

Water-surface profiles were developed for the different flood frequencies using the COE 22 J2 L212 step-backwater computer program (Reference 5). Profiles were determined for the desired flood frequencies based on a constant roughness relationship developed from the reproduction of historical flood profiles.

Starting water-surface elevations for the Monongahela River were obtained from a continuation of profile computation and high-water marks started at Locks and Dam No. 2. These high-water marks and stage-discharge measurements were carried upstream to tie into a similarly well-defined rating curve at Locks and Dam No. 3. The Borough of Elizabeth falls within this longer portion of the Monongahela River and the water-surface elevations are better defined within the community as a result.

falls within this longer portion of the Monongahela River and the water-surface elevations are better defined within the community as a result.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross-section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

All elevations used in this study are referenced to the National Geodetic Vertical Datum of 1929 (NGVD), formerly referred to as Sea Level Datum of 1929. Locations of the elevation reference marks used in the study are shown on the maps.

The hydraulic analyses for this study are based on the effects of unobstructed flow. The flood elevations shown on the profiles are valid only if hydraulic structures remain unobstructed, and dams and other flood control structures operate properly and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (Reference 6). In cases where the 100- and 500-year flood boundaries are close together, only the 100-year boundary has been shown.

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). Small areas within the flood boundaries may lie above the flood elevations and, therefore, may not be subject to flooding. Owing to limitations of the map scale and lack of detailed topographic data, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood can be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodway in this report is presented to local agencies as a minimum standard that can be adopted or that can be used as a basis for additional studies.

The floodway presented in this study was computed on the basis of equal conveyance reduction from each side of the flood plains. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown. A portion of the floodway width for the Monongahela River extends beyond the corporate limits.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for the flooding source affecting the Borough of Elizabeth.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH [2] (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Monongahela River A	23.03	920	33,320	5.5	748.9	748.9	749.8	0.9

[1]Miles above confluence with Allegheny River
[2]This width extends beyond corporate limits

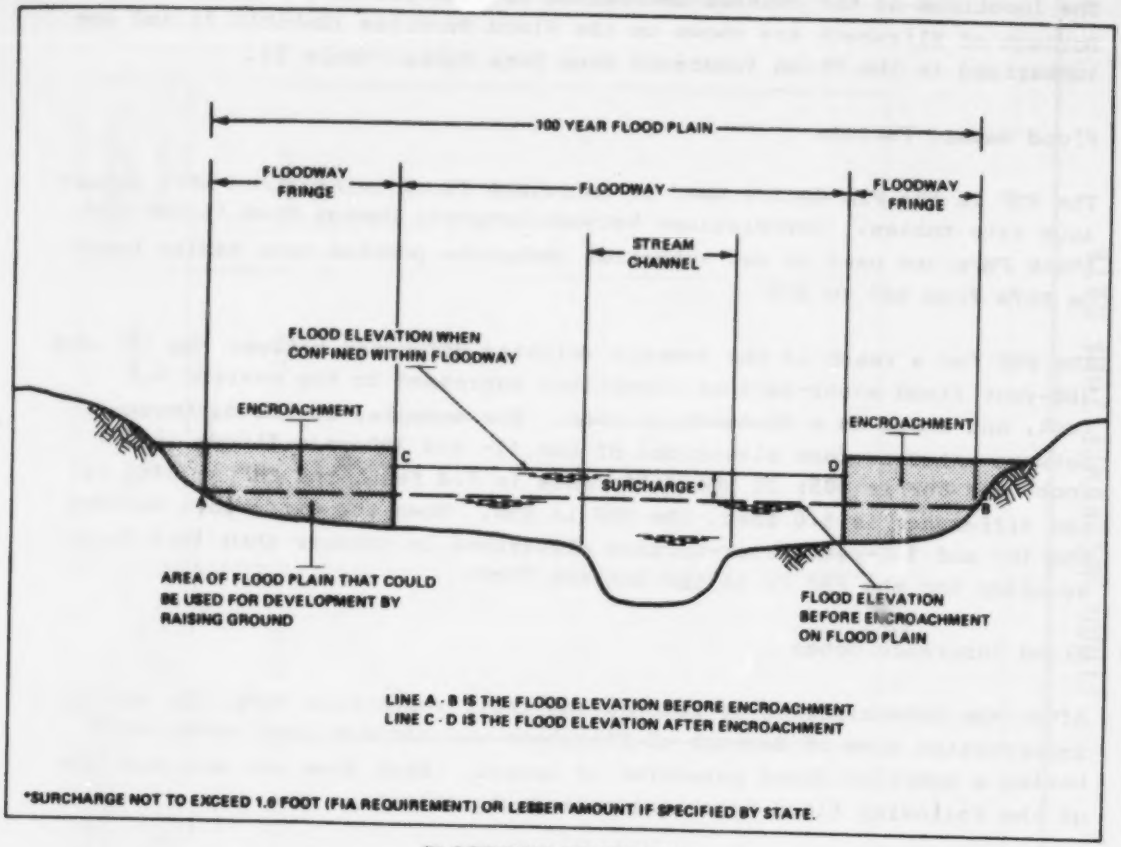
TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

BOROUGH OF ELIZABETH, PA
(ALLEGHENY CO.)

FLOODWAY DATA

MONONGAHELA RIVER


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
A
B
SURCHARGE*
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC

Figure 2

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding source of Borough of Elizabeth are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 3).

5.2 Flood Hazard Factors

The FHF is the FIA device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted dfference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of Borough of Elizabeth was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A14:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHF.
Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also, areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding source studied in detail in the Borough of Elizabeth.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Monongahela River Reach 1	01	-7.0	-1.9	+4.0	070	A14	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

BOROUGH OF ELIZABETH, PA
(ALLEGHENY CO.)

FLOOD INSURANCE ZONE DATA

MONONGAHELA RIVER

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Borough of Elizabeth is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

A Flood Plain Information report was prepared by the COE for Allegheny County, Pennsylvania (Reference 7). The report concerns flooding on the Ohio, Allegheny, Monongahela and Youghiogheny Rivers. Base flood elevations presented in this report are from 1.0 to 1.5 feet higher for the Monongahela River than the elevations presented in the Flood Plain Information report. These differences are the result of recent revisions by the COE to the elevation-frequency curves at Locks and Dam Nos. 2, 3 and 4.

A study prepared in 1975 by the Pittsburgh District of the COE concluded that overbank flow on the Monongahela River is relatively ineffective for a 500-year flood (Reference 4).

Flood Insurance Studies for the contiguous communities of the Townships of Elizabeth and Forward, and the Boroughs of West Elizabeth and Jefferson have been or are currently being prepared (References 8, 9, 10 and 11). Profiles for the Monongahela River in these studies were computed sufficiently beyond the corporate limits of each study where additional high-water marks were available to ensure consistent and compatible results in the adjacent reaches. The results of all these studies will be in exact agreement except for the Township of Elizabeth Flood Insurance Study. The base flood elevations presented in this report for the Monongahela River are from 1.0 to 1.5 feet higher than those presented in the Township of Elizabeth study. These differences are the result of recent revisions by the COE to the elevation-frequency curves at Locks and Dam Nos. 2, 3 and 4.

This study is authoritative for purposes of the Flood Insurance Program, and the data presented here either supersede or are compatible with previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of the Insurance and Mitigation Division of the Federal Emergency Management Agency, Regional Director, Region III Office, Curtis Building, Room 700, Sixth and Walnut Streets, Philadelphia, Pennsylvania 19106.

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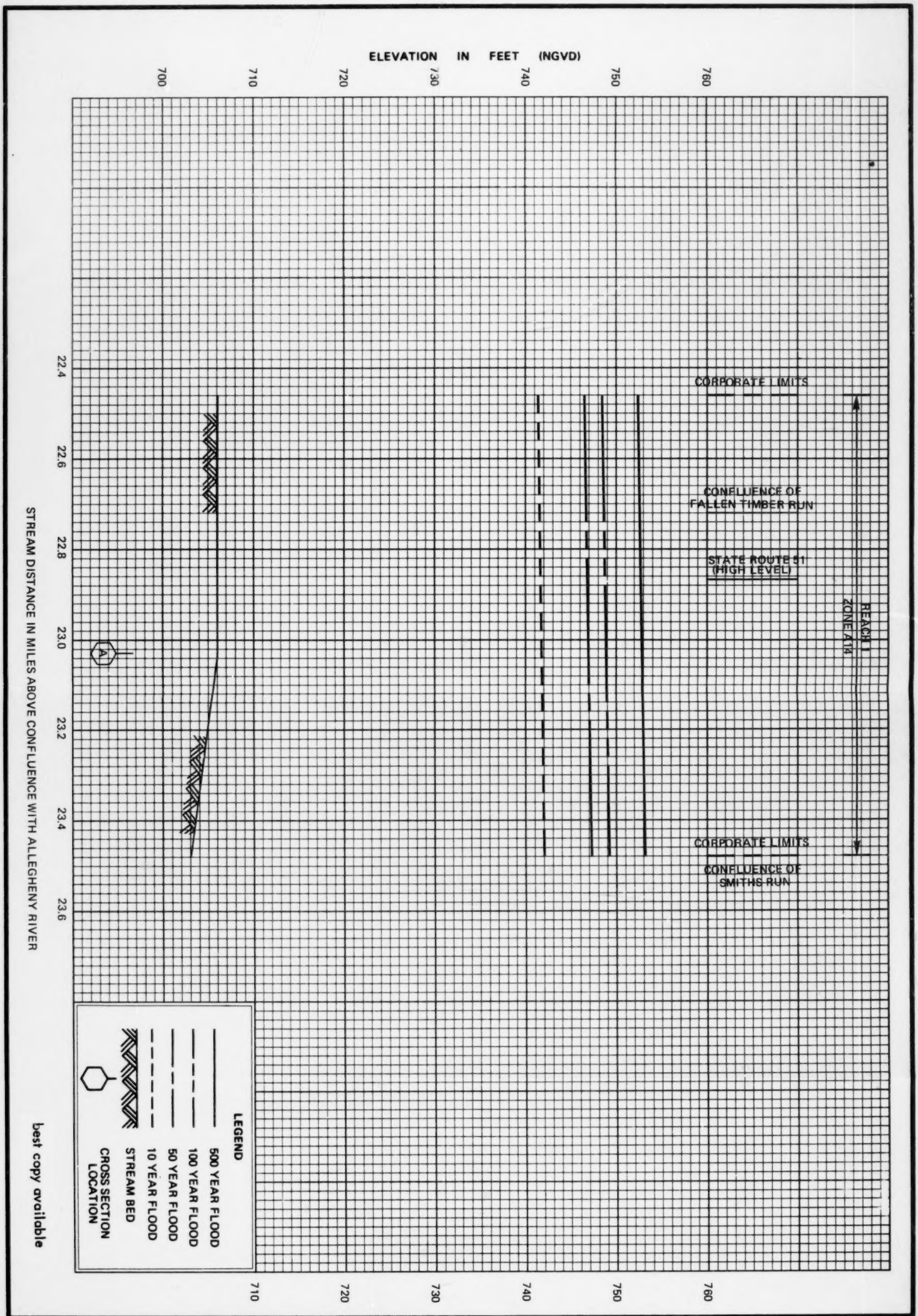

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01P	FEDERAL EMERGENCY MANAGEMENT AGENCY Federal Insurance Administration **BOROUGH OF ELIZABETH, PA** (ALLEGHENY CO.)	**FLOOD PROFILES** **MONONGAHELA RIVER**